ER 54 – Electrician Regulations Answer Schedule

Notes:1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

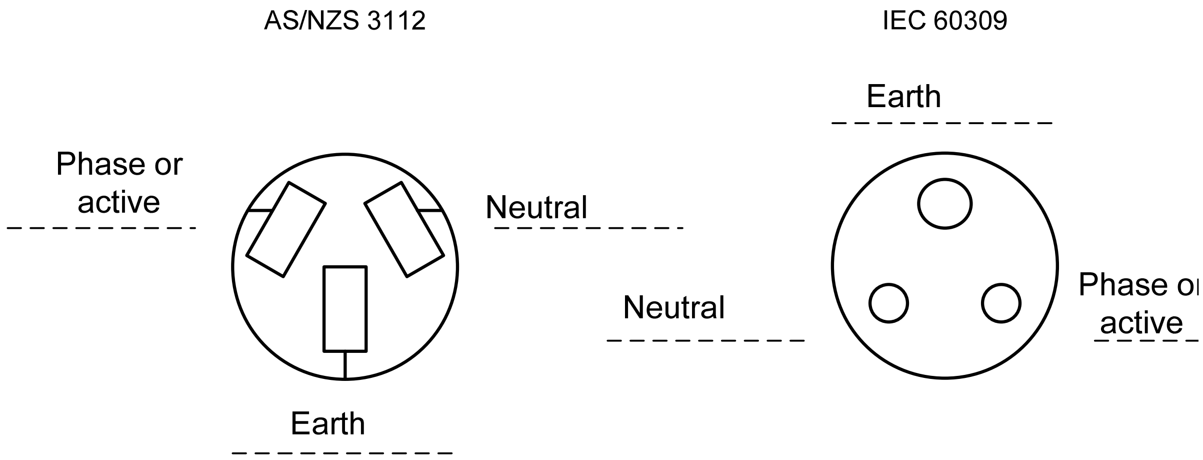
Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: ● A degree or diploma or certificate of a stated kind recognised by the Board. ● The successful completion of a competence programme, degree, or course of studies accredited by the Board: ● A pass in a specified examination or any other assessment set by the Board or by another organisation approved by the Board: ● By reference to registration with, or a licence issued by, an overseas organisation that performs functions that correspond wholly or partly to those performed by the Board: ● Experience in the provision of services of a particular kind: ● A certain level of competence.	(2 marks)	EA 86 (1)	
(b) Any TWO of: ● Person who apply for practising licences or provisional licences. ● Person who hold practising licences or provisional licences ● Persons who apply for renewals of practising licences or provisional	(2 marks)	EA 108 (1) EA 85(1)(d)	
(c) ● In the event of a fault between a live part and an exposed conductive part which could give rise to a prospective touch voltage exceeding 50 V a.c. or 120 V ripple-free d.c	(1 mark)	AS/NZS 3000 1.5.5.3(b)	
● a protective device shall automatically disconnect the supply to the circuit or electrical equipment concerned.	(1 mark)	AS/NZS 3000 1.5.5.3(b)	
(d) Any ONE of:	(2 marks)		
● Other circuits including submains and final subcircuits supplying fixed or stationary equipment		AS/NZS 3000 1.5.5.3(d)	

Question 1	*Marks*	*Reference*	*Marking notes*
● Other circuits where is can be shown that people are not subjected to touch voltages that exceed safe values.		AS/NZS 3000 5.7.2(b)	
(e) Any ONE of:	(2 marks)		
● Suitable measures shall be taken to prevent the device operating while carrying current.		AS/NZS 3000 2.3.2.2.1	
● May include interlocking with an associated circuit breaker		AS/NZS 3000 2.3.2.2.1 Note	
● May include that the device will only be operated by authorised.		AS/NZS 3000 2.3.2.2.1 Note	
● May include warning notices		AS/NZS 3000 2.3.2.2.1 Note	
(f) (i) Any ONE of:	(1 mark)		
● Not be installed within or above any classified zone		AS/NZS 3000 2.9.2.5(e)	
● Shall not be installed within any classified zone		AS/NZS 3000 6.3.4.6	
(ii) Any ONE of	(1 mark)		
● It must have a degree of protection of IPX4		AS/NZS 3000 2.9.2.5 (j)(A)	
● It is provided with a shield to prevent water spraying on it		AS/NZS 3000 2.9.2.5 (j)(B)	
● Sprinkler heads that could project water on the switchboard are provided with suitable deflectors		AS/NZS 3000 2.9.2.5 (j)(C)	
● Sprinkler heads are of the dry type		AS/NZS 3000 2.9.2.5 (j)(D)	
(g) No connection, other than that made by an earthing conductor, shall be made between the primary and secondary windings.	(2 marks)	AS/NZS 3000 4.14.5	
(h) ● Protected by an RCD.	(1 mark)	AS/NZS 3000 6.2.4.2(b)(ii)	
● With a fixed rated residual current not exceeding 30 mA.	(1 mark)	AS/NZS 3000 6.2.4.2(b)(ii)	
(i) Any FOUR of:	(2 marks)		
● Continuity of the earthing system		AS/NZS 3000 8.3.5	The same information can be taken from clauses 8.3.3 or 8.3.4
● Insulation resistance testing		AS/NZS 3000 8.3.6	
● Polarity		AS/NZS 3000	

Question 1	*Marks*	*Reference*	*Marking notes*
- Correct circuit connections - Verification of impedance		8.3.7 AS/NZS 3000 8.3.8 AS/NZS 3000 8.3.9	

(j)



One mark for each correct set	(2 marks)		

Question 2	*Marks*	*Reference*	*Marking notes*
(a) (i) (1) Any ONE of:	(1 mark)		
• Heavy-duty conduit		AS/NZS 3000: Table 3.5 Column 2	
• Enclosing in heavy duty insulating conduit without further mechanical protection		AS/NZS 3000: 3.11.3.1(a)	
(2) Any ONE of:	(1 mark)		
• Medium-duty conduit encased in concrete		AS/NZS 3000: Table 3.5 Column 3	
• Cables are enclosed in insulated wiring enclosures encased in concrete		AS/NZS 3000: 3.11.3.1(b)	
(ii) 500 mm	(1 mark)	AS/NZS 3000: Table 3.6	
(iii) Any ONE of:			
• The route of the underground cable shall be recorded on a plan	(1 mark)	AS/NZS 3000 3.11.4.6(b)	
The plan shall be located in the MEN switchboard in building No.1	(1 mark)	AS/NZS 3000 3.11.4.6(b)	
• The location of the wiring system is marked and recorded in a suitable permanent location	(1 mark)	AS/NZS 3000 3.11.4.5 Exception	
That is readily available to any person involved with excavation work at the location of the wiring system.	(1 mark)	AS/NZS 3000 3.11.4.5 Exception	
(iv) To minimise damage to wiring systems installed underground during manual or mechanical excavation works.	(1 mark)	AS/NZS 3000 3.11.4.6	
(b) (i) A category B system	(1 mark)	AS/NZS 3000: Table 3.5 Column 8	
(ii) Any ONE of:	(1 mark)		

Question 2	*Marks*	*Reference*	*Marking notes*
• 500 mm		AS/NZS 3000: Table 3.6	
• 575 mm		AS/NZS 3000: Figure 3.14	
(iii) Any FOUR of:	(2 marks)		
• Shall be laid on a bed of not less than 50 mm of sand or friable soil free of sharp stones.		AS/NZS 3000: 3.11.4.2	
• Covered by not less than 50 mm of the same material.		AS/NZS 3000: 3.11.4.2	
• Additional mechanical protection placed not more than 75mm above the wiring system; and		AS/NZS 3000: 3.11.4.3(a)	
• Additional mechanical protection not less than 150mm wide		AS/NZS 3000: 3.11.4.3(b)	
• Additional mechanical protection that overlaps the wiring system by at least 40mm on each side.		AS/NZS 3000: 3.11.4.3(c)	
• * Precast concrete slabs having a thickness of not less than 40 mm and a classification of not less than grade 20 in accordance with AS 3600 or NZS 3102. * Concrete slabs cast on site having a thickness of not less than 100 mm. * A continuous concrete pour having a thickness of not less than 75 mm. * Fibrous cement slabs having a thickness of not less than 12 mm. * Bricks manufactured specifically for the protection of electric cables. * Polymeric cable cover strip complying with AS 4702. * Other materials which offer the same degree of protection afforded by the materials above		AS/NZS 3000: 3.11.4.3(d) (i) to (vii)	Candidates can reference only one of these requirements in the answer

Question 3	*Marks*	*Reference*	*Marking notes*
(a) • Starting and stopping the motor	(1 mark)	AS/NZS 3000: 4.13.1.1(a)	
• Emergency stopping in accordance with clause 2.3.5	(1 mark)	AS/NZS 3000: 4.13.1.1(b)	
• Isolating the motor for mechanical maintenance, in accordance with clause 2.3.6	(1 mark)	AS/NZS 3000: 4.13.1.1(c)	
(b) Motors rated above 370 W	(1 mark)	AS/NZS 3000: 4.13.2	
(c) (i) The protective device shall disconnect, directly or indirectly, not less than one supply conductor.	(1 mark)	AS/NZS 3000: 4.13.3(b)(i)	
(ii) The protective device shall disconnect, directly or indirectly, not less than two supply conductors.	(1 mark)	AS/NZS 3000: 4.13.3(b)(ii)	
(d) (i) • The HRC fuses operate much faster than the thermal overloads.	(1 mark)	GK	
• Under short-circuit conditions the HRC fuses will disconnect the circuit before damage occurs.	(1 mark)	GK	
(ii) • The thermal overload begins to operate when current is sustained past the overload setting (typically between 80% to 120% of full load current).	(1 mark)		
• The thermal overload will operate before the HRC fuse	(1 mark)		

Question 4	*Marks*	*Reference*	*Marking notes*
(a) • The new 16 mm^2 underground mains from the plinth on the boundary to a new meter box.	(½ mark)	ESR 6A(1)(b)	
• The new 16 mm^2 internal mains between the new meter box and new main switchboard.	(½ mark)	ESR 6A(1)(b)	
• The new main switchboard.	(½ mark)	ESR 6A(1)(b)	
• The new main earthing lead and earth electrode.	(½ mark)	ESR 6A(1)(b)	
(b) • The new 16 mm^2 underground mains from the plinth on the boundary to a new meter box.	(½ mark)	ESR 65	
• The new 16 mm^2 internal mains between the new meter box and new main switchboard.	(½ mark)	ESR 65	
• The new main switchboard.	(½ mark)	ESR 65	
• The new main earthing lead and earth electrode.	(½ mark)	ESR 65	
• The new RCD protected socket outlet on the outside of the house.	(½ mark)	ESR 65	
• The additional lights and power points in the existing living areas.	(½ mark)	ESR 65	
(c) (i) Any ONE of:	(½ mark)		
• Part 2		GK	
• Section 3		GK	
(ii) Any ONE of: • Section 8 • Clause 1.8	(½ mark)	GK	
(d) (i) Any ONE of:	(1 mark)		
• Electrical Safety Certificate		ESR 74A(1)	
• Certificate of compliance and electrical safety compliance certificate		GK	
• Combined certificate of compliance and electrical safety certificate.		GK	
(ii) Any SIX of: • A statement that the person issuing it is satisfied that the installation or part installation is connected to a power supply and is safe to use • State whether the electrical safety certificate relates to the	(3 marks)	ESR 74A(3)	The 3rd bullet point can be answered from ESR 67 (2)(b)

Question 4	*Marks*	*Reference*	*Marking notes*
whole of the installation or just to specified parts of it ● Identify the location of the installation or part installation to which it relates ● In or have on it the authentication mark, as specified in regulation 111B ● Give the date on which the connection was done ● Be signed and dated by the person who did the connection ● Give the name and registration number of the person who did the connection or, if that person was acting under an employer licence, the employer’s licence number.			

Question 5	*Marks*	*Reference*	*Marking notes*
(a) (i) An active (phase) to frame fault on the appliance.	(1 mark)	GK	
(ii) They show the earth fault loop for the fault at "A" on the Class I electrical appliance.	(1 mark)	GK	
(iii) It is considered to be the earth-fault loop with the lowest impedance.	(1 mark)	GK	
(b) To verify that the kA rating of the protective devices are capable of safely interrupting the prospective short circuit current.	(2 marks)	GK	
(c) Any ONE of: ● To verify that the kA rating of the protective devices are capable of safely interrupting the prospective short circuit current. ● It provides the highest value of impedance that exists in the installation. ● To verify that sufficient fault current will flow that ensures the protective device operates within 0.4 s	(2 marks)		
(d) (i) Because the route lengths are the length of the phase conductor from the point of connections to the point of use and are related to a disconnection time of 0.4 S	(2 marks)	AS/NZS 3000: Table B1 Note 3	
(ii) Any ONE of: ● Install a 16A, type B, MCB ● Install a 20A, type B, MCB ● Install a 20A HRC fuse ● Install a 16A, type C, MCB ● Install a 20A RCBO	(1 mark)	AS/NZS 3000: Table B1	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) Any THREE of: ● Consumers mains ● Equipment installed as required by an electricity distributor for service protection, control or electricity consumption metering purposes ● Ancillary equipment, measuring devices, and associated wiring …… provided that this wiring and equipment are confined within or on the switchboard. ● Equipment ……… associated with a safety service that is connected on the supply side of a main switch ● Equipment ……… associated with alternative supply system that is connected on the supply side of a main switch ● Fault current limiters. ● Surge diverters installed to protect consumers mains or main switchboards.	(3 marks)	AS/NZS 3000: 2.3.3.1 Exception	Some of the answers can be obtained directly from clauses 7.2 or 7.3
(b) Where supply is provided at more than one point in any building, a prominent notice shall be provided at each main switchboard, indicating the presence of other supplies and the location of other main switchboards.	(2 marks)	AS/NZS 3000: 2.3.3.4(d)	
(c) (i) Any THREE of: ● Where the final subcircuits originate from the same supply. ● The continuity of the neutral conductor shall not depend on connections at the terminals of electrical equipment including control switches. ● Final subcircuits that contain a common neutral shall be controlled and protected by linked circuit breakers or linked switches ● The neutral conductor shall be marked at switchboards to indentify the associated live conductors in accordance with clause 2.9.5.5 ● Alternative sources of supply to a single appliance shall have a common isolating	(3 marks)	AS/NZS 3000: 2.2.1.2	

Question 6	*Marks*	*Reference*	*Marking notes*
switch. (ii) Any ONE of: ● Shall be determined from the current carrying capacity of the associated active conductors ● It is determined by the total current to be carried, where there is more than one active conductor	 (1 mark)	 AS/NZS 3000: 2.2.1.2 AS/NZS 3000: 3.5.2(a)(ii)	
(d) Any ONE of:	(1 mark)		
● Functional switching may be used where switching of electrical equipment or part of an electrical installation is required for operational control only and not for safety reasons. ● Functional switches shall be installed in a readily accessible position in the same room, or immediately adjacent to the entrance to the room, in which the room heater or room heaters are located. ● Functional switches shall be installed in a readily accessible position immediately adjacent to the entrance to, or within, the room or area in which the heating system is located.		AS/NZS 3000: 2.3.7.1 AS/NZS 3000: 4.9.3 AS/NZS 3000: 4.10.4	

Question 7	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: ● A touch voltage hazard between conductive parts and the mass of earth. ● Protective devices may not operate under fault conditions. ● Under voltage could damage equipment	(4 marks)	GK	
(b) ● It must be at a voltage agreed between the electricity retailer and the customer. ● Unless otherwise agreed, and except for momentary fluctuations, must be maintained within 6% of the agreed supply voltage.	(1 mark) (1 mark)	ESR 28(2)(a) ESR 28(2)(b)	
(c) Aluminium has a lower conductivity than copper, so the cross-sectional area must be greater to equal the current carrying capacity of the copper conductor.	(2 marks)	GK	
(d) Shall be determined in relation to the summation of the cross-sectional areas of the individual conductors forming the largest active conductor to be protected.	(2 marks)	AS/NZS 3000: 5.3.3.1.2	

Question 8	*Marks*	*Reference*	*Marking notes*
(a) (i) Any TWO of: • AS/NZS 3123 • IEC 60309 • AS/NZS 3131	(1 mark)	AS/NZS 3000 4.4.1.1	
(ii) • Installed in such a way that the earth-continuity conductor is connected to the slot on the radial line	(1 mark)	ESR 61A(1)	
• Installed in such a way that the order of connection, in a clockwise direction when the socket-outlet is viewed from the front, is— (i) earth-continuity conductor: (ii) active conductor: (iii) neutral (or other) conductor.	(1 mark)	ESR 61A(1)	
(iii) • Yes	(½ mark)		
• AS/NZS 3000: 2.6.3.1(c) requires such circuits to be RCD protected.	(½ mark)		
(b) Any ONE of:	(1 mark)		
• The means of isolation for the appliance is accessible with the appliance.		AS/NZS 3000: 4.4.2.1 Note	
• Shall be provided with a means of electrical isolation that is adjacent to the appliance location and is accessible with the appliance in the installed position.		AS/NZS 3000: 4.18.1	
• The means of isolation shall be a plug to a switched socket outlet that may be located in an accessible position, but has a separate switch operating in all live (active and neutral conductors located in an accessible position.		AS/NZS 3000: 4.18.1(b)	
(c) (i) • Yes,	(½ mark)		
AS/NZS 3000:2.6.3.1(b).	(½ mark)		
(ii) • The default clearances shown in figure 4.9 shall apply	(1 mark)	AS/NZS 3000: 4.5.2.3.4(c)	
• A fixed guard constructed of rigid fire-resistant material may be required.	(1 mark)	AS/NZS 3000: 4.5.2.3.4(c)	
(iii) • Shall not present a mechanical	(1 mark)	AS/NZS 3000:	

Question 8	*Marks*	*Reference*	*Marking notes*
loading that exceeds the capacity of the ceiling panel. - Shall not operate at a temperature that would cause deformation, discolouration or other forms of deterioration of the ceiling panel	 (1 mark)	4.5.2.4(a) AS/NZS 3000: 4.5.2.4(b)	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) $I_L = \frac{P}{\sqrt{3} \times 400}$ $I_L = \frac{68000}{\sqrt{3} \times 400}$ $= 98.15A$ Allowance for load increase = 9.81 Total load = 107.96A From Tables 27(2) the re-rating factor is 1.04 From Table 13, column 23, rating of 16 mm^2 is 106A Cable rating = 106 x 1.04 = 110.24 A 16 mm^2 cable will meet the load requirements	(½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (1 mark)		
(b) Maximum volt drop permitted is 400 x 0.025 = 10V. $V_d/A.m = \frac{V_d \times 1000}{I \times L}$ $= \frac{10 \times 1000}{107.76 \times 45}$ $= 2.06\ V_d/A.m$ From Table 42, the 1.54 V_d/A.m for a 25 mm^2 cable Volt drop $= \frac{V_d/A.m \times I \times L}{1000}$ $= \frac{1.54 \times 107.96 \times 45}{1000}$ $= 7.49V$ Therefore a 25 mm^2 cable will meet the voltage drop requirements	(½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (1 mark)		
(c) A 25 mm^2 cable will meet the voltage drop and load requirements	(1 mark)		